

Learning Newsletter

Higher Order Thinking

The Marlborough Science Academy

All resources to be found on U drive in the teaching and learning folder

The Inference Square

What QUESTIONS do you still have?



The **inference square** is a particularly effective strategy for stimulating curiosity and for encouraging students to take ownership of the enquiry process. It is also useful for students who tend to take information at face value, as it encourages them to:

- ‘read between the lines’ – drawing inferences from what they see or read
- take a more critical approach to the information and evidence they are using during their enquiry, therefore increasing the validity their conclusions.

Inference square: instructions

The inference square stimulates curiosity by starting with an intriguing source – usually a picture or photograph – that will act as a starting point for enquiry.

1. Organise students into groups of four and distribute the source and the inference square template.
2. Working outwards from the centre, students must respond to a series of questions:

What does this source/picture/information tell you for certain?

What can you infer (work out) from this source?

What does this source not tell you?

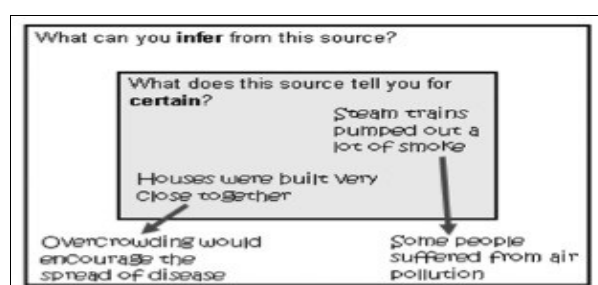
What questions do you have?

These questions draw students into an increasingly sophisticated analysis and evaluation of the source and spur them to create enquiry questions of their own.

Inference square: teaching tips

With a more complex picture, you could overlay a grid and ask each group of students to look in detail at a different section. This tends to encourage students to look longer and ‘see more’ within their particular section.

Make the skill of inference more explicit and visible to your students by asking them to draw lines between facts they have recorded in the central box and the related inferences. The example is taken from an inference square on Victorian towns.



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Practice Paper Generator

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Six Thinking Hats



Overview: This strategy encourages you to use six types of thinking linked to a topic.

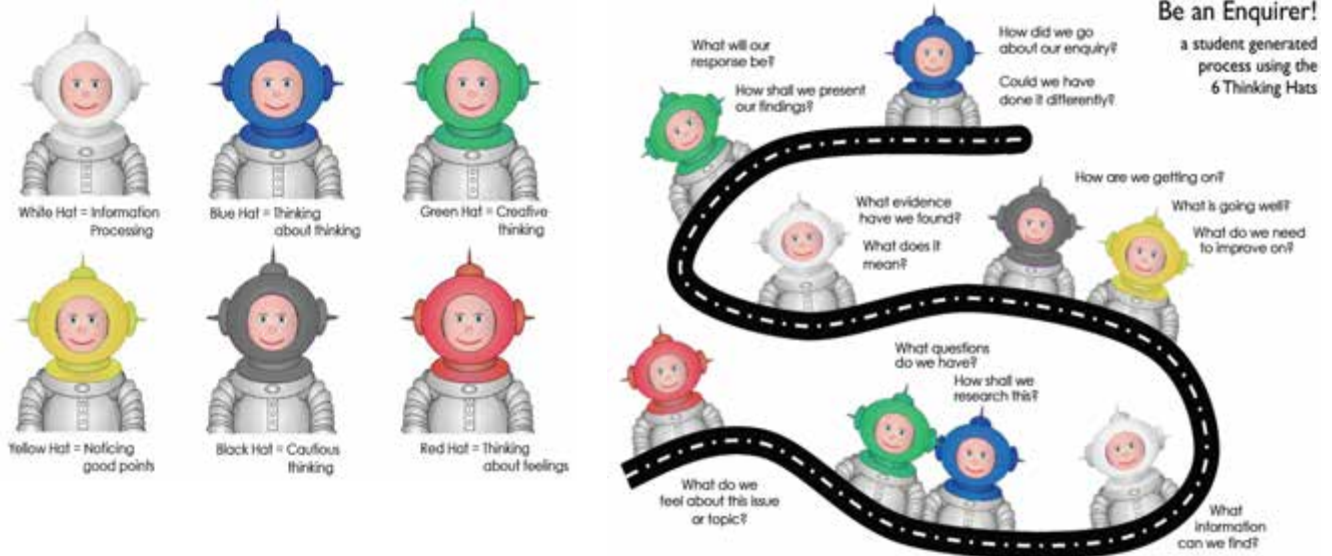
- **White Hat Thinking** – identifies facts and information
- **Yellow Hat Thinking** – looks at all the good things
- **Black Hat Thinking** – looks at all the bad things
- **Green Hat Thinking** – creative solutions, off the wall ideas
- **Red Hat Thinking** – explores gut feelings and emotional reactions
- **Blue Hat Thinking** – thinks about the thinking process

Step 1: Teacher sets an issue or problem. Teacher reminds you about each thinking hat.

Step 2: Teacher encourages you to think about the problem from all thinking hats points of view.

Step 3: You are asked to use the information as part of an assignment or as the basis for a test question

Structuring enquiry using the 6 thinking hats



The above demonstrates how the 6 Thinking Hats can be used to help students focus on the kind of thinking involved at different stages of an enquiry activity. Students can use the hats to help formulate a series of questions that they then can use to guide their enquiry. The hats can be sequenced in a variety of other ways. Students can also have to ask each other, more probing questions – perhaps concerning the relevance and value of the information used or the validity of the conclusions reached. The point of this exercise is for students to use the Hats to represent where their thinking had got to about the process of enquiry, and about how new knowledge and understanding is created. This can then be revisited and refined over time.

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Living Graphs



You draw or are given a pre printed line graph. You are then given a number of statements relating to events or things people might have said that relate to the graph. You have to decide where on the graph (at what time point), this was most likely to have occurred, and give reasons to justify their decisions. This strategy encourages you to make connections between the line graph and the reality for people and events along the graph.

Practice Paper Generator



Question number: 1

Describe how the body receives oxygen from the heart and why it is known as a double pump?

Model answer and / or guidance [shown once a user submits their own answer]

The heart is a muscular pump. When it beats it pumps blood to the lungs and around the body. The amount of blood pumped can be calculated:

$$\text{heart rate} \times \text{stroke volume} = \text{cardiac output}$$

These increase when exercising.

The heart has four chambers. The two atria collect the blood. The two ventricles

Optional link [to provide users with additional support and ideas]

http://

Describe how the body receives oxygen from the heart and why it is known as a double pump?

1 FROM 5

Next question Try again

The heart has four chambers. The two atria collect the blood. The two ventricles pump the blood out of the heart. Valves prevent the blood from flowing backwards. The septum separates the two sides of the heart. The right side of the heart pumps de-oxygenated blood (blood not containing oxygen) to the lungs to pick up oxygen. The left side of the heart pumps the oxygenated blood from the lungs around the rest of the body. The pulmonary circuit carries blood to the lungs to be oxygenated and then back to the

This piece of software allows you to create examination style questions along with examples of model answers.

Students can choose random questions and set themselves time limits. Once they submit their answer the model answer comes up, so comparisons can be drawn.

The software installation suite can be found in this months resources folder on the T drive. To save yourselves time why not download a past paper from the web along with the mark scheme and cut and paste them into the software.

This can easily be uploaded to our VLE.

It's a Mystery



A 'mystery' is a problem solving activity based round a given central question that is open to more than one reasonable answer. The information or 'clues' needed to answer the question are presented on separate slips of paper that the students will analyse, sort, sequence and link.

Mysteries are a good introduction to enquiry because they:

- provide students with an enquiry experience that fits neatly into one lesson
- provide you with the opportunity to make enquiry structures and skills explicit and memorable
- motivate – the narrative thread that runs through a mystery will successfully engage students and they will be eager to find out more about the characters at the centre of the action and events.

Mystery: instructions for making

1. Identify a theme in your topic that will lend itself to enquiry or which would benefit by being 'problematized' and 'personalised' in a narrative. For example a science project on energy might lend itself to a mystery, 'Why did Mr and Mrs Green sell their car?'
2. Make a set of 15-25 slips that provide the necessary information.

Continuing with the Greens' car sale example, a set of slips might include:

- 6-7 background or context clues (e.g. Mrs Green's driving licence/wage slips/ pension plan/date/method for measuring CO2 emissions)
- 4-5 actions or causes of change (e.g. doctors report on Mrs Green's heart, CO2 emissions report, visit of Greenpeace activist)
- 4-5 reactions or effects of change (e.g. application to join the local golf club, email regarding sale of house, car sale advert)
- 2-4 red herrings to confuse. They are relevant to the theme but not to the enquiry question (e.g. formula for combustion, nuclear energy facts)
- 1-3 pieces of irrelevant information (e.g. Mr Green's favourite food)

Mystery: instructions for teaching

1. Organise the students into groups of four and give them the key 'mystery' question.
2. Show them the information slips and explain that their task is to solve the mystery by providing a full answer to the question. Encourage them to think of a strategy for doing this.
3. Hand out the information slips and allow the students to get on with it. Some will sequence the slips into a story, others may group together those that relate to each character.
4. Hear the conclusions as well as the different strategies that students have used.
5. If appropriate, students could then be asked to classify the information in a variety of different ways, e.g. into sets of background, long-term, short-term and trigger causes.
6. Other possibilities could involve asking students to prioritise the reasons they have found or linking the evidence in a Concept Map.

Mystery: teaching tips

Introduce the mystery tool by asking, 'Who in real life solves mysteries?' Having established that this is typically the work of detectives, you can ask, 'How do they do this?' and draw out from your students suggestions about the enquiry process.

Vary the level of difficulty by changing the amount, complexity and literacy demands of the information, by introducing all the slips at once, or distributing them in stages.

Allow room between your pieces of information for ambiguity and inference. Enquiry often throws up facts that can appear unrelated until new evidence provides the link. Allow questions to clarify meanings and terminology on the slips.

Mystery: talking about thinking

Words that might help in the course of the activity and in the plenary are:

<i>enquire</i>	<i>infer</i>	<i>plan</i>	<i>link/connect</i>	<i>probable</i>	<i>sequence</i>	<i>refine</i>	<i>certain</i>
<i>analyse</i>	<i>hypothesise</i>	<i>conclude</i>	<i>evidence</i>	<i>possible</i>	<i>predict</i>	<i>data</i>	

Plenary questions might include:

- How did you solve the mystery?
- Is that a full answer; is there anything left unexplained?
- What assumptions/inferences have you made: are they reasonable?

What have you learned that could help you to find answers to your own questions? What other information could be presented as a mystery?

Activities using the Disposition Bricks (blue) or Thinking Bricks (red)

(NB. The bricks use a 'false perspective' design that enables you to build a wall, bridge, or any structure you like! Following an activity, students can be encouraged to 'knock down a wall', or 'build a bridge' by picking out and giving concrete examples of how they used a particular skill or displayed a particular quality - as in the activities below).

Activities are suitable for pairs, small groups or the whole class working together.

1 How did you go about doing the task? Pick out the bricks that show the kind of thinking that you were doing.

Can you give an example of when you were doing this kind of thinking?

2 Can you sequence the bricks to show the stages that your thinking went through? What did you do first $\frac{1}{4}$ and then..? Build a tower or road to show the steps you took.

3 Try to agree on which was the most important skill (or disposition) that you needed to do the task.

4 Select a brick (or knock a brick out of the wall) that shows the kind of thinking (or disposition) that you found the easiest.

5 Select a brick that shows the kind of thinking (or disposition) that you found the hardest. Why did you find it a challenge? What helped you to rise to the challenge?

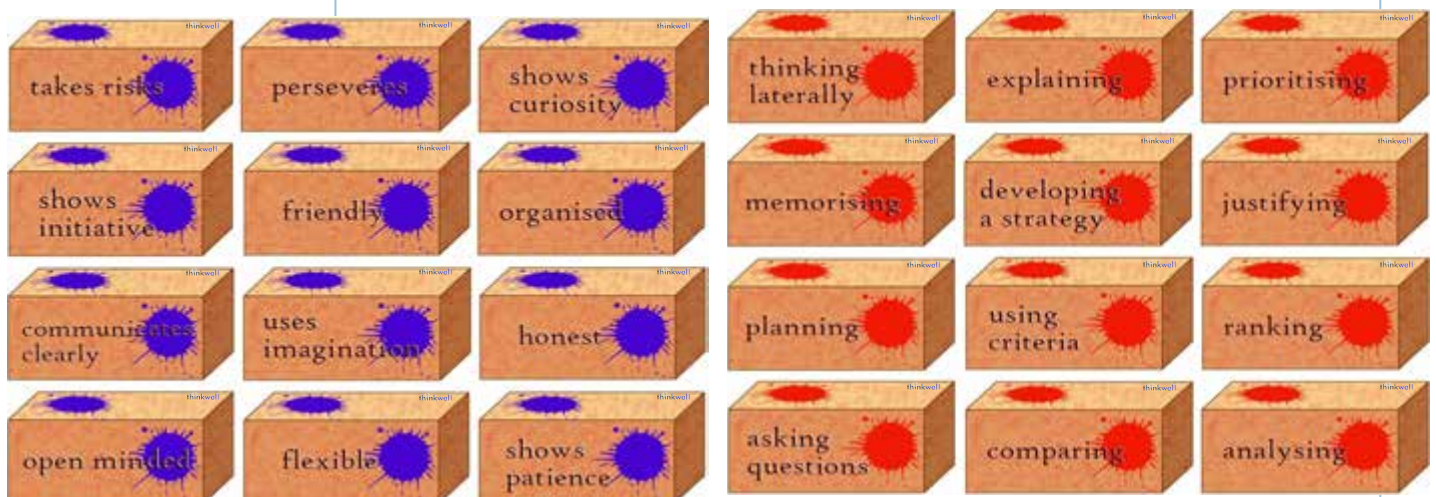
6 Select a brick with a 'thinking word' that was new to you today.

7 Where else have you used these skills? Select a brick that shows a type of thinking that you have used before in other lessons. Which ones? Can you explain what you were doing?

8 Where else might you be able to use these skills? Select a brick that shows a type of thinking that you think might be useful in a different lesson or outside school.

9 Using either the skills or disposition bricks, conduct an '11/21/41' challenge. In other words, why a particular skill/disposition might be useful aged 11, why it might be useful when they are 21, and why it might still be useful aged 41. Give students 60 seconds of game show style music to consider their response. (Vary the numbers for different age groups.)

10 Using either the skills or disposition bricks, conduct a 'W.T.P.' challenge. In other words, ask students 'What's The Point?' of learning to develop a particular skill or disposition. Give students 60 seconds of game show style music to consider their response.



Thinking Skills 7 implications for classroom teaching

1) Set open-ended challenges

Open-ended challenges do not have a single, absolutely correct answer or a single way of arriving at a correct answer. They enable learners to respond creatively, construct their own meaning, and develop strategies and solutions which they see as personal – they spark student’s curiosity and create a ‘need to know’.

2) Make thinking important

If we want learners to see thinking as important, we need to provide time and space for it to happen in the classroom. We need to allow students time to think before responding to questions and time to reflect on and talk about their learning. Thinking skills and dispositions should feature in learning objectives, classrooms should be organised to encourage collaboration and dialogue. Classroom displays should make thinking visible, showing thinking words, thinking phrases, question prompts, thinking tools and the students’ own thoughts and questions.

3) Make thinking explicit

Students are asked to share not only what they have learned about the subject, but also what they have learned about the process that made the learning possible – their thinking. They are also encouraged to think about how they might use their thinking skills both across the curriculum and beyond in everyday life. We call thinking about thinking ‘metacognition’. Metacognition requires lots of support and the quality of a teacher’s questioning and listening will be key to its success.

4) Ask ‘rich’ questions

We can develop our students’ ability to think more skilfully by asking ‘rich’ questions. They are rich because they can draw out a wealth of possible responses regarding knowledge, know-how, thoughts, feelings and speculations. Being a rich questioner involves asking questions about things you cannot already know the answer to; questions, for example, about what and how students think and feel. We shouldn’t expect an immediate reply to rich questions; students will need time for reflection. Being a rich questioner also involves listening closely to their responses so that follow-up questions can be asked that both challenge and extend their thinking even further, and ‘join up’ students’ thinking so they can learn from each other.

5) Enable collaborative learning

Giving students meaningful and challenging opportunities to work and collaborate with others is important. Increasingly it is recognised that collaborative learning and dialogue between learners is important, not only because students are given opportunities to develop social and teamwork skills, but also because talking about what and how they are learning improves their understanding and their capacity for reasoning and argument. It is also important to make explicit the type of talk that we need to use if we are to think together effectively in groups. Termed ‘exploratory talk’, it is characterised by the use of questioning, reasoning, explanation, and speculation. Contributions build on previous comments and aim to be both constructive and critical.

6) Promote self-management

To enable learners to be more self-directed, they need to be given opportunities to plan, manage and monitor their own learning. This of course demands that we make the relevant skills and capabilities ‘visible’ to our students and help them to develop a language for talking about the variety and value of their thinking and for evaluating their own development.

7) Make connections across contexts

Research on classroom learning has found that students typically show little ability to flexibly apply what they have learned in one curriculum area to help them with a new and different problem in another. Skills that could be generalised and transferred remain stubbornly welded to the context (and sometimes even to the room!) in which they were learned, and are still less likely to be applied to the solution of informal problems in everyday life. It is important, therefore, to acquaint students with the whole problem of transfer, and show them how to learn for transfer.

A to Z's

Students create a pictorial or written alphabet in which each letter is illustrated by something relevant to the topic – it could be the local area, the school, the year group, work, play, ‘growing up’ etc. It is important that each word or image represents something about the theme. This activity involves discussion with others and can lead to interesting discussion and raise questions for further enquiry. It can reveal students’ values and perceptions about the place or topic for which they are creating the A-Z.

Beat the teacher

The teacher invites students to ask questions about a topic of their choosing. If the teacher is unable to answer the question it is recorded. In this way a ‘question bank’ is established.

This activity can allow teachers to demonstrate that we don’t have the answers for everything, and helps build a classroom culture where questioning and enquiry are commonplace.

The questions generated can provide the basis for further study.

Collage and montage

Collages and montages are a good way of helping students to build up a representation of a theme or topic.

The teacher may provide students with pictures, newspaper cuttings, magazines, or ask students to collect their own materials. It’s important to see the product as a starting point for enquiry. The key is to get students to share the thinking that went into making the collage, for instance what categories they chose.

Collages can be the basis for whole class discussion, and other students may be encouraged to ask questions about them. The montages can be used as a basis to discuss the students’ perceptions of the issue in comparison to other people’s points of view.

Data race

This activity involves students finding quick answers to questions they may have. The teacher sets students off on a ‘race’ to find out key bits of information on a topic. The teacher may suggest sources, or allow students to choose how to find the information. A suitable time limit can be set.

The activity is a quick way of gathering and sharing information about a topic. It can lead to discussions about the nature of information and data sources, and the teacher can raise questions about the accuracy and sources of the information, and suggest other ways of approaching the topic.

Future forecasts – what if...?

The teacher encourages students to produce ‘scenarios’ that predict how social or technological trends might influence people’s behaviour in the future or what greater effect they might have on society. For example, what would happen if: flying was so heavily taxed that no-one could afford to fly any more?

Cars were able to be powered by water?

People lived until they were 150years old?

This activity allows students to explore open-ended questions and compare desirable, probable and possible futures.

The forecasts may be used as a basis for research into actual predictions and to likely changes.

5 Whys

This is simple technique to get students asking questions. The aim is to ask ‘**why**’ questions in response to five consecutive answers. For example: Q: Why do you exercise? A: Because it’s healthy. Q: Why is it healthy? A: Because it’s good for me. Q: Why is it good for me? And so on.

The technique can encourage people to examine and express the underlying reasons for their behaviour and

attitudes. It promotes an enquiring stance and challenges students to examine their thinking and reasoning.

Analysis of activity

The teacher asks the students to list or represent in detail all the tasks, actions, objects, performers and interactions

involved in a process. For instance, what is involved exactly in sending a text message, or in riding a bike, or making

a football boot?

In documenting the minute detail of an activity, gaps or surprises are often presented – new considerations – that

may open up further questions or focus the direction of an enquiry. Any gaps or new considerations can be used to drive further research.

Diamond 9

This activity involves arranging nine items or choices into priority order, in the shape of a diamond with the most

important at the top and the least important at the bottom. The activity is useful in helping students make choices

between competing alternatives. When done as a group, it can encourage negotiation and the clarification of ideas.

Filter for focus

In pairs or groups students work together to agree the top five most important words in a piece of text, sections on a web page, sub-themes of a topic, and so on. When ready each group takes it in turns to write their key items on the board. Other groups do the same, but can only add words that are not already there. The activity encourages students to focus on the most important aspects of a topic.

When working well, it can help students to clarify their understanding of the essential features of a theme or issue.

SWOT analysis

In a SWOT analysis students consider an issue or decision and analyse it in terms of its strengths (or positives), its weaknesses (or negatives), what opportunities and what threats it presents. This activity goes beyond simple comparisons by analysing an issue or an argument in terms of its strengths and

Most Likely to?

Preparation

Preparation and duplication of Most Likely To..... statements. Statements could range from readily recognisable to ambiguous depending on the ability of your students.

Launching

Students should be encouraged to think about generalisations through real life situations which motivate them and put the learning into a wider relevant context, e.g. “Who is most likely to support a London based football team and why?”

Although most students are likely to support the local teams there are many reasons why some of them might not. This can be used for a starting point for the activity that follows.

Instructions

Explain that the statements are characteristics that can be categorised, and tell them what these categories are. Explain that it is their job to decide which statements are most likely to... fit into each category. They need to justify their choices.

Managing the Activity

Students may not need to record their decisions and reasoning in writing: sometimes the discussion is a satisfactory end in itself. You may wish to circulate among the groups in order to refocus the discussions.

Raising the challenge in your learning objectives:

When writing your learning objectives be as clear and specific as possible. Use words that allow both the pupil and yourself to assess if the intended learning has taken place by the end of the lesson during the debrief/plenary.

So if you have a specific lesson in mind and want to pitch the lesson higher to raise the challenge use the trigger words below to help you write your learning objectives.

Basic Order Learning: UNDERSTANDING/COMPREHENSION

If your lesson is pitched at NC Level 4 then lower order-thinking tasks are required. Trigger words/activities: compare, contrast, estimate, explain.

Middle Order Learning: APPLICATION

If your lesson is pitched at NC Level 5 then middle order-thinking tasks are required. Trigger words/activities: solve, predict, demonstrate, relate.

Middle Order Learning: ANALYSIS

If your lesson is pitched at NC Level 5/6 then middle order-thinking tasks are required. Trigger words/activities: differentiate, categorise, speculate, outline.

Higher Order Learning: SYNTHESIS

If your lesson is pitched at NC Level 6/7 then higher order-thinking tasks are required. Trigger words/activities: construct, build, create, summarise, design.

Higher Order Learning: EVALUATION

If your lesson is pitched at NC Level 7+ then higher order-thinking tasks are required. Trigger words/activities: judge, justify, conclude, criticise, assess.

V. EVALUATE (according to some set of criteria, and state why)		
Verbs for Objectives	Model Questions	Instructional Strategies
appraise judge criticize defend compare	What fallacies, consistencies, inconsistencies appear? Which is more important, moral, better, logical, valid, appropriate? Find the errors.	Challenging assumptions Journaling Debates Discussions and other collaborating learning activities Decision-making situations

VI. CREATE (SYNTHESIS) (combining elements into a pattern not clearly there before)		
Verbs for Objectives	Model Questions	Instructional Strategies
choose combine compose construct create design develop do formulate hypothesize invent make make up originate organize plan produce role play tell	How would you test...? Propose an alternative. Solve the following...? How else would you...? State a rule.	Modeling Challenging assumptions Reflection through journaling Debates Discussions and other collaborating learning activities Design Decision-making situations

Resources to be found on the U drive

Teaching and Learning

Connections

Preparation

Lists of paired statements need to be prepared relating to a specific topic.

The statements should be devised so that some have obvious links, some have possible links and some are unrelated.

Launching

The activity could be introduced through an abstract example e.g. "Manchester United FC wins the Premiership title" and "Manchester United FC are a popular football team" - students need to consider whether there is any connection between these two statements. If so, why?

Introduce the idea of connections for the topic in question and use a relevant example to discuss and begin the activity.

Instructions

Students are to read through the statements and discuss them in small groups/pairs.

Each group should make decisions about the type of connection, which exists, between the statements. They should choose out of the following options:

M = Must be a connection

C = Could be a connection

N = No connection

For each pair of statements, students should be able to explain how and why they made their decision.

Once the students have completed all the statements, they could discuss their decisions with another pair. Were they the same? If not, they should try to justify their decision to the other pair; can they reach a common decision?

Managing the Activity

Begin by questioning students' understanding of the statements. Reinforce any words/concepts that they don't understand.

Encourage students to ask questions about the information on the statements.

Inform students that there are no definite right or wrong answers - the most important thing is that they can explain why they made their decision.

It's all in the pitch!

Pitch initial class activities at a lower level e.g. level 4 to enable students to have success and grow in confidence, but place alongside work pitched at level 5 and 6. Students will often want to attempt the higher level work.

MULTIPLE INTELLIGENCES & BLOOM'S TAXONOMY

(This matrix was developed by Ralph Firozzo in 1997 & updated in 2004)

⊕ Scheme of work: **Circulatory System** GCSE PE Mr Fitzgibbon

Seven ways to be smart	Bloom's Taxonomy: Six Thinking Levels					
	REMEMBERING (2)	UNDERSTANDING (2)	APPLYING (4)	ANALYSING (4)	EVALUATING (6)	CREATING (6)
<u>Verbal</u> I enjoy reading, writing & speaking	List the components of the circulatory system	Explain why we must exercise our heart	Design a web page or power point presentation to promote a healthy heart	Design a presentation that compares different peoples blood pressure	Write a speech to Tony Blair, to convince him of the need to increase our exercise rates	Produce a piece of writing to predict what our likely future is (a) if we don't start looking after our hearts (b) if we do.
<u>Mathematical</u> I enjoy working with numbers & science	Draw a graph to show the target zone for cardiovascular fitness	Prepare a flow chart to illustrate the sequence of events the heart goes through each time it beats.	Calculate the amount of time the heart beats in a week, year, lifetime Ask for a worksheet	Organise a survey to find out about pulse rates in the class and graph the results. Write a brief paragraph to explain your findings.	Design a scheme to encourage more people to be healthy. Draw your scheme as a flow diagram or a power point presentation to show how it would work.	Make a list of ways to improve a healthy heart. Rank the strategies
<u>Visual/Spatial</u> I enjoy painting, drawing & visualising	Copy a diagram of the heart as a pump in a double circulatory system, show the flow of blood and label the parts	Create a spider gram showing the effects of exercise on the heart	Make a papiermâché map to include relevant information about the circulatory system	Draw a circulatory system mind map, try and think of at least 5 branches, use colour and illustrations.	Create an advertising campaign to promote a healthy heart: leaflets, posters, badges, logos etc. Include a brief description of where you would want them displayed or distributed.	Imagine you visit earth in the year 2080. What state will our health service will be in if we don't improve our lifestyles draw a storyboard to show you're thought.
<u>Kinaesthetic</u> I enjoy doing hands-on activities, sports & dance	Mime what happens blood as it leaves the heart	Make cut outs to represent different parts of the heart write facts about each onto the cut out shape.	Build a model of the circulatory system and explain how it works. Ask for a worksheet.	Play the circulatory system game and then explain what you learnt from the game.	Create a circulatory system game and then teach it to someone else	Create a walking explanation with cards and props to show the issues associated with heart disease.

The above grid provides students with a choice of activities that combine learning styles with higher order thinking. Points are awarded to varying degrees depending on the order of thinking involved. Lower order tasks have a lower value (2) whilst higher order thinking task are worth (6). Over a unit students need to a mass 18 points. You can shade in tasks which are compulsory to complete.

Why not share your ideas with others, or show new resources you have found / created.

If you want to talk about learning and teaching feel free to email me at
m.fitzgibbon@marlborough.herts.sch.uk or drop into my office for a chat.